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SURVEY AND IDENTIFICATION OF MAJOR FUNGI CAUSING ROOT ROT ON DATE PALM AND THEIR RELATIVE IMPORTANCE IN EGYPT

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ABSTRACT

Date palms under the Egyptian conditions are subjected to infection with different diseases caused by many soil-borne pathogenic fungi which may cause considerable losses in the offshoots and trees. A survey was carried out during four years 2005-2008 in seven governorates. Aswan governorate showed the highest disease severity (45.00%), followed by Luxor (37.50%), Behaera (30.50%), Marsa-Matrouh (25.00%), Ismailia (5.00%), Sharkyia (3.75%) and Giza (2.50%). Isolation and identification of associated fungi showed that the most frequent fungi were *Fusarium* spp. and *Thielaviopsis paradoxa*, while the least frequent were *Botrydiplodia theomromae* and *Rhizctonia solani*. The most virulent fungi were *F. oxysporum, F. moniliforme, F. solani* and *T. paradoxa* which were responsible for the root rot incidence that started with gradual yellowing that reached the palm tip followed by quick death. All the tested cultivars were susceptible to infection by the isolated pathogenic fungi. Hayany cultivar was the most susceptible to infection, followed by Sammany cultivar. While Zaghloul cultivar was the least susceptible.

Key Words: Date palm, root rot, soil borne pathogenic fungi, *Fusarium oxysporum, F. moniliforme, F. solani, Thielaviopsis paradoxa, Botrydiplodia theomromae*, *Rhizctonia solani*

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) roots are liable to attack by several pathogenic soil borne fungi, that causing serious diseases. Plant pathogens, *viz*. fungi, nematodes, bacteria, and viruses can cause diseases or damages in palm trees (Chase and Broschat., 1991). Several fungi were recorded as causal pathogens of root rot on date palm, *viz*., *Fusarium oxysporum*; *F. solani*; *F. moniliforme*; *F. semitectium; F. equiseti*; *Phoma* sp.; *Chaetomium* sp.; *Alternaria* sp.; *Cladosporium* sp.; *Macrophomina phaseolina*; *Thielaviopsis paradoxa*; *Diplodia phoenicum*; *Phomopsis phoenicola* and *Rhizoctonia solani* (Abdalla *et al*., 2000; El- Zawahry *et al*., 2000; Sarhan, 2001; Suleman, *et al.*, 2001; El-Morsi, 2004; Mansoori and Kord, 2006; El Deeb *et al*., 2007; Samir *et al*., 2009). This study aimed to throw some light on the distribution of date palm root rot and its causal agents in different governorates in Egypt.

MATERIALS AND METHODS

Field survey:

Roots and soil (rhizosphere) samples were collected from naturally infected date palm and offshoots growing in different locations in seven governorates, *viz*.; Aswan, Luxor, Marsa-Matrouh, Giza, Ismailia, Sharkyia and Behara. These were selected depending on, the large area cultivated, irrigation system, enviromental conditions (during different growing seasons, summer, autumen, winter and spring, 2005-2008) and type of soils (Sarhan, 2001 and Suleman, 2001). Disease incidence and Disease severity Index (DSI) were carried out according to Cooke *et al*. (2006) and the scale was suggested by Abdalla *et al*. (2000).

Isolation and identification:

Date palm roots and rhizoshpere (trees or offshoots) were collected from orchard infested localities and carefully clarified from the large particles of soil. Samples of roots were taken at least 15-20 cm apart, then maintained in a cool dry state during transit to the laboratory to minimize contamination with the saprophytic micro-organisms. Samples were washed carefully with tap water to remove the adhering soil particles, and ten pieces (10 cm length) representing each sample were sectioned into small pieces (1 cm length) and

surface sterilized with 1% sodium hypochlorite solution for 2 mins., washed in sterile distilled water (SDW), and then dried between folds of sterilized filter papers. The sterilized root sections were transferred on potato dextrose agar (PDA) and the plates were incubated at 25±2°C. Emerged fungi were isolated and purified using the single spore technique and/or the hyphal tip method according to Wang and Wen (1997). The frequency of the isolated fungi was calculated separately from each collected sample. Stock cultures were maintained on PDA slants and kept in a refrigerator at 5°C. for further studies. Stocks were routinely sub-cultured on fresh slant every month. The fungal colonies growing in the culture plates were identified according to their morphological characteristics according to Nelson *et al*. (1983); Barnett and Hunter (1999); John and Summerell (2006). Micro-organisms from root surfaces (rhizosphere) were isolated according to Bao *et al.* (2004). The frequency of the isolated fungi from the root rotted samples and from rhizosphere was separately calculated according to the following formula: % Fungal frequency= Number of isolates of each fungs/Total number of all isolates X 100

Pathogenicity test of the most frequent isolated fungi:

Pathogenicity test of the most frequent fungi, *i.e. Fusarium oxysproum* Schlecht, *Fusarium solani* (Mort.) Sacc, *Fusarium moniliforme* Sheldon, *Fusarium semitectum* Berk and Ravenel, *Botryodiplodia theobrome* Pat, *Thielaviopsis thielavioides* Peyr. and *Rhizoctonia solani* Kuhn., which were isolated from diseased roots was carried out in the greenhouse of Fruit and Woody Trees Diseases Research Department-Agric. Res. Center, Giza-Egypt. Seeds of *Phoenix dactylifera* were provided by a commercial producer. They were surface-disinfested for 10 min in a sodium hypochlorite solution NaOCl (1.5% available chlorine), soaked under tap water for 24 h, and then sown in black plastic bags (15 cm) filled with a sterilized mixture of equal portions (v/v) of soil, sand and clay. The seedlings were allowed to grow for 6 months or to the 2-3 leaves-stage. Five bags (each contained one date palm) representing each of the tested varities, *viz*. Zaghloul, Sammany and Hayany were used as rreplicates for each tested fungus. Seedlings and soil infested protocol was carried out by two methods:

a- Seedlings injection: Six-month-old plants were inoculated as described by Abdalla *et al*. (2000) by injecting 1 ml of hyphal or spore suspension, and the concentration was adjusted to $1X10^6$/ ml using a haemocytometer (Mather and Roberts, 1998). The hyphal and spore suspension were injected into the crown using a hypodermic needle and syringe for each fungus. After inoculation, all plants were covered separately with plastic bags for 48 h to maintain high humidity. Five plants of each cultivar were inoculated with each isolate, and corresponding controls were injected with SDW. The pots were arranged in a complete randomized design. The pathogenicity test was conducted twice. Pathogenicity was evaluated at 30, 45, 60 and 90 days after inoculation and disease reaction was rated as described before.

b- Soil infestation: Soil was infested according to El-Zawahry *et al*. (2000) by adding 100 ml/hyphal or spore suspension ($4X10^6$/ml) to each black plastic bag representing each pathogenic fungus. Soil was irrigated every 3-4 days to ensure distribution of the tested fungus. After three months from soil infestation plants were uprooted and their roots were washed by water to remove soil particles, then percentage of infection and disease severity were recorded. Re-isolation was carried out from infected tissues.

Varietal reaction:

Reaction of the different varieties of date palm (Zaghloul, Sammany and Hayany) to infection with the different pathogenic fungi, *viz*. *F. oxysproum, F. solani, F. monliforme, T. paradoxa, B. theobromae* and *R. solani* was studied by using healthy 3-years-old offshoots. Soil infestation was adopted by adding 1000 ml/hyphal or spore suspension ($4X10^6$/ ml) to each pot from each of the pathogenic fungi from active culture. In the other method for infection, plants were inoculated by injecting 1 ml of hypal or spore suspension ($1X10^6$) of the tested fungi into the crown using a hypodermic needle and syringe. After inoculation, all plants were covered separately with plastic bags for 48 h to maintain high humidity. Five offshoots representing each variety were inoculated with each isolate, and corresponding controls were injected with sterilized distilled water (SDW). The Pathogenicity test was conducted twice. Pathogenicity was evaluated at 3, 6 and 9 month(s) after inoculation and disease reaction was rated as described before. The data were displayed in

means after analysis of the least significant difference at 95% (LSD≤0.05) by Co-Stat Program (version 8.0).

RESULTS AND DISCUSSION

Results

Field survey:

Disease survey carried out during 2005-2008 growing seasons show clearly that typical symptoms of date palm root rot was observed in all governorates under study. Percentages of disease incidence as well as disease severity were found to be different from governorate to another, even from cultivar to the other. Data, (Table, 1) and (Fig, 1) show the disease incidence and disease severity percentages of root rot affected all studied cultivars of date palm in the different inspected locations in all governorates. The percentage of disease incidence and disease severity values were differed by the locality. The highest percentage of disease incidence (DI%) and severity (DS%) of root rot were recorded in Aswan (80%DI and 45%DS) followed by Luxor, Behera and Marsa-Matrouh (65%DI and 37.50%DS), (60%DI and 30%DS) and (50%DI and 25%DS), respectively. whereas the lowest percentage of disease incidence and severity were observed in Ismailia, Sharkyia and Giza (20%DI and 5%DS), (15%DI and 3.75%DS) and (10% DI and 2.5%DS), respectively.

Table (1): Field survey of root rot of different cultivars of date palm in different governorates.

Governorates	Locations	Total number of date palm trees*	Disease incidence%	Disease Severity %
Marsa-Matrouh	Siwa	436344	50.00	25.00
Behera	Rashid – Edko	1128466	60.00	30.00
Sharkyia	Belbeas	1214798	15.00	3.75
Ismailia	Al- Ferdan	479766	20.00	5.00
Giza	El-Mansoria	514586	10.00	2.50
Luxor	Luxor	38393	65.00	37.50
Aswan	Abo El Ryesh-Al Akab	1008429	80.00	45.00

*Anonymous (2009). Study of Important Indicators of the Agricultural Statistics. Ministry of Agriculture and Soil Reclamation. Economic Affairs Section, Egypt.

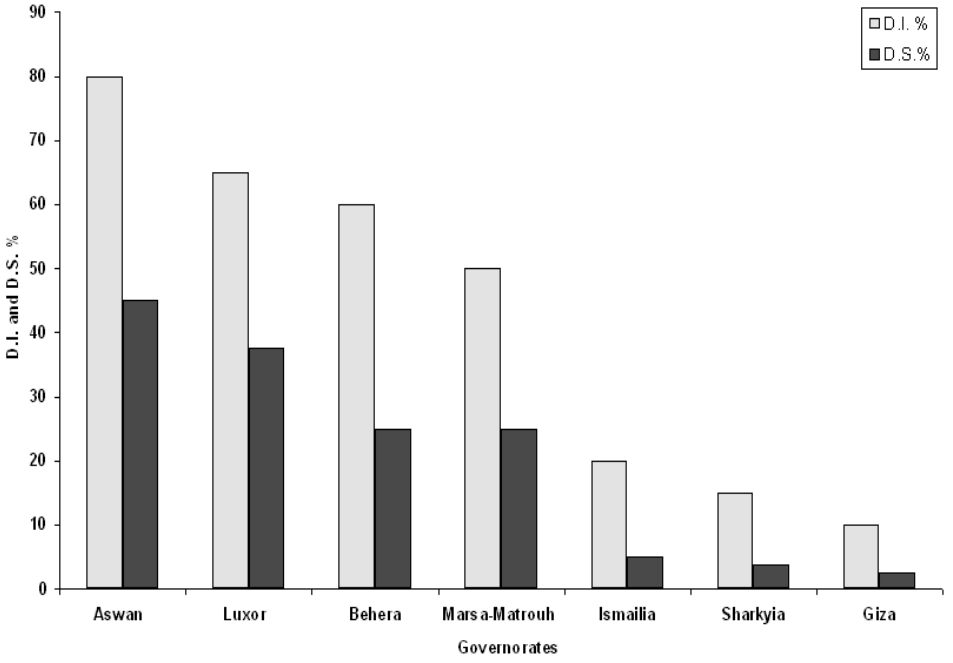

Fig. (1): Disease incidence and disease severity percentage of root rot of date palm in different governorates.

Isolation and identification:

Eight fungi, *viz*. *Fusarium* sp., *Botryodiplodia theobromae*, *Thielaviopsis paradoxa*, *Gliocladium* sp., *Rhizoctonia solani*, *Aspergillus* sp., *Phomopsis* sp., *Stemphylium* sp. were isolated from diseased root samples of date palm collected from different governorates. Also, eight different fungi, *viz*. *Fusarium* sp., *Aspergillus* sp., *Thielaviopsis paradoxa*, *Mucor* sp., *Cladosporium* sp., *Stemphylium* sp., *Alternaria* sp. and *Rhizoctonia solani* were isolated from rhizosphere samples of date palm collected from different governorates. Data in Table (2) show that diseased samples collected from Marsa-matrouh governorate gave four fungi isloated from roots, *viz*. *F. oxysporum, F. solani, Phomopsis* sp., and *Stemphylium* sp. (60, 30, 5 and 5%, respectively). Also, gave three fungi isolated from the rhizosphere, *viz*. *F. solani, Aspergillus* sp. and *Rhizoctonia solani* (70, 20 and 10%, respectively). Behaera governorate gave three fungi isolated from roots, *viz*. *T. paradoxa, B. theobromae* and *F. semitectum* (50, 30 and 20%, respectively). Also, gave five fungi isolated from the rhizosphere, *viz*. *T. paradoxa, F. oxysporum,*

*Aspergillus sp.***,** *Cladosporium sp.* and *Mucor sp.* (40, 20, 20, 10 and 10%, respectively). Sharkyia governorate gave two fungi isolated from roots, *viz*. *F. oxysporum* and *F. semitectum* (90 and 10%, respectively). Also, three fungi were isolated from the rhizosphere, *viz*. *Rhizoctonia solani, Aspergillius* sp. and *F. semitectum* (70, 20 and 10%, respectively). Ismailia governorate gave three fungi isolated from roots, *viz*. *F. oxysporum, F. solani* and *Rhizoctonia solani* (50, 35 and 15%, respectively). Also, four fungi were isolated from the rhizoshphere, *viz*. *F. oxysporum, Rhizoctonia solani, Aspergillus* sp. and *Mucor* sp. (70, 10, 10 and 10%, respectively). Giza governorate gave three fungi isolated from roots, *viz*. *F. oxysporum, F. moniliforme* and *Gliocladium* sp. (60, 30 and 10%, respectively). Also, four fungi were isolated from the rhizosphere, *viz*. *Stemphylium* sp.*, Aspergillus* sp.*, Alternaria* sp. and *Mucor* sp. (30, 30, 20 and 20%, respectively). Luxor governorate gave three fungi isolated from roots, *viz*. *F. oxysporum, F. moniliforme* and *Aspergillus* sp. (60, 25 and 15%, respectively). Also, two fungi were isolated from the rhizosphere, *viz*. *F. semitectum* and *Aspergillius* sp. (70 and 30%, respectively). Aswan governorate gave three fungi isolated from roots, *viz*. *F. oxysporum, F. moniliforme* and *F. solani* (60, 20 and 20%, respectively). Also, six fungi were isolated from the rhizosphere, *viz*. *F. oxysporum, F. semitectum, F. solani, F. subglutinans, F. clamidospores* and *Aspergillus* sp. , being 30, 20, 20, 10, 10, and 10%, respectively. On the other hand, Marsa-Matrouh governorate showed the highest count of *F. oxysporum* (60%) from roots, while *F. solani* (70%) from the rhizosphere. Behera governorate showed the highest count of *T. paradoxa* (50 and 40%) from roots and rhizosphere, respectively, while *B. theobromae* showed 30% from roots. Sharkyia governorate showed the highest count of *F. oxysporum* (90%) from roots, while *R. solani* (70%) was from the rhizosphere. Ismailia governorate gave the highest count of *F. oxysporum* (50 and 70%) from roots and rhizosphere, respectively, while *R. solani* (15 and 10%) was obtained from roots and rhizosphere, respectively. Giza governorate samples gave the highest count of *F. oxysporum* and *F. moniliforme* (60 and 30%) from roots, respectively. Luxor governorate gave the highest count of *F. oxysporum* and *F. moniliforme* (60 and 25%) from roots, respectively. Aswan governorate yielded the highest count of *F. oxysporum* isolated from the roots (60%) and (30%) from the rhizosphere. In general, the highest fungus distribution in all governorates under study, was *F. oxsporum*, followed by *T. paradoxa*, while *R. solani* showed the lowest distibution in all governorates under study.

Table (2): Occurrence and frequency (%) of fungi isolated from decline root rot and soil of date palm in different governorates.

Governorates	Cultivar	Number of samples	Samples (Roots/Rhizosphere)	Associated fungi	Number of isolates	Frequency %
Marsa-Matrouh	Siway	10	Roots	*Fusarium oxysporum*	60	60
				Fusarium solani	30	30
				Phomopsis sp.	5	5
				Stemphylium sp.	5	5
		10	Rhizoshpere	*Fusrium solani*	105	70
				Aspergillus sp.	30	20
				Rhizoctonia solani	15	10
Behera	Hayany	6	Roots	*Thielaviopsis paradoxa*	50	50
				Botryodiplodia theobromae	30	30
				Fusarium semitectum	20	20
		6	Rhizoshpere	*Thielaviopsis paradoxa*	92	40
				Fusarium oxysporum	46	20
				Aspergillus sp.	46	20
				Cladosporium sp.	23	10
				Mucor sp.	23	10
Sharkyia	Zaghloul	6	Roots	*Fusarium oxysporum*	90	90
				Fusarium semitectum	10	10
		6	Rhizoshpere	*Rhizoctonia solani*	126	70
				Aspergillus sp	36	20
				Fusarium semitectum	18	10
Ismailia	Samany	8	Roots	*Fusarium oxysporum*	50	50
				Fusrium solani	35	35
				Rhizoctonia solani	15	15
		8	Rhizoshpere	*Fusarium oxysporum*	147	70
				Rhizoctonia solani	21	10
				Aspergillus sp.	21	10
				Mucor sp.	21	10
Giza	Zaghloul	8	Roots	*Fusarium oxysporum*	60	60
				Fusarium moniliforme	30	30
				Gliocladium sp.	10	10
		8	Rhizoshpere	*Stemphylium* sp.	39	30
				Aspergillus sp.	39	30
				Alternaria sp.	26	20
				Mucor sp.	26	20
Luxor	Medjhol	12	Roots	*Fusarium oxysporum*	60	60
				Fusarium moniliforme	25	25
				Aspergillus sp.	15	15
		12	Rhizoshpere	*Fusarium semitectum*	175	70
				Aspergillus sp.	75	30
Aswan	Medjhol	20	Roots	*Fusarium oxysporum*	60	60
				Fusarium moniliforme	20	20
				Fusarium solani	20	20
		20	Rhizoshpere	*Fusarium oxysporum*	78	30
				Fusarium semitectum	52	20
				Fusarium solani	52	20
				Fusarium subglutinans	26	10
				Fusarium clamidospores	26	10
				Aspergillus sp	26	10

Pathogenicity test of the most frequent isolated fungi:

Different isolated fungi, *viz*. *F*. *oxysporum*, *F*. *moniliforme*, *F*. *solani*, *F*. *semitectum*, *B*. *theobromae*, *T*. *paradoxa* and *R*. *solani* from different locations and different governorates were used to investigate their pathogenic capabilities on young date palm seedlings, originated from seeds of three vars. Zaghloul, Sammany and Hayany. Data concerning the pathogenicity test on different wounded varieties of date palm seedlings after three months are shown in Table (3). It is evident that all tested fungi were able to induce root rot reaction, except *F*. *semitectum*. *F*. *oxysporum* isolate1 obtained from Aswan governorate was the most virulent one, where it showed 40.6% disease severity on the three varieties, followed by, *F*. *oxysporum* isolate 4 obtained from Luxor (31.8% DS). While, *F*. *oxysporum* isolates 2, 6, 3 and 5 gave 23.4, 20.1, 19.9 and 19.7% DS, respectively on the average. On the other hand, *F*. *solani* and *T*. *paradoxa* recorded 23.8 and 23.8% DS on the average. *B*. *theobromae*, *F*. *moniliforme* and *R*. *solani* recorded 19.5, 14.8 and 14.3%DS, respectively on the average for the three vars. Zaghloul variety was the most susceptible to all the tested fungi, except *F*. *semitectum*, followed by vars. Sammany and Hayany, respectively. Data also show that increased time after inoculation led to increasing the disease severity for all fungi and cultivars. Data in Table (4) indicate that using the unwounded method, *F*. *oxysporum* isolate1, obtained from Aswan governorate, was the most virulent one, 21.1% disease severity on the average for all three varieties, followed by, *F*. *oxysporum* isolate 4 obtained from Luxor (15.0%DS). While, *F*. *oxysporum* isolates 2, 5, 3 and 6 gave 10.5, 10.2, 9.9 and 9.1%DS, respectively. On the other hand, *F*. *solani* and *T*. *paradoxa* recorded 16.3 and 13.7%DS, on the average for the all three varieties. *F*. *moniliforme, R*. *solani* and *B*. *theobromae* recorded 10.2, 9.6 and 9.4%DS, respectively on the average. Zaghloul var. was the most susceptible with all the tested fungi, except *F*. *semitectum*, followed by vars. Sammany and Hayany, respectively. Data also show that increased the time after inoculation led to increasing the disease severity by all the tested fungi and varieties.

Table (3): Pathogenicity test using different varieties of wounded date palm seedlings after 30, 45, 60 and 90 days after inoculation.

Fungi	% Disease severity on date palm vars.															Mean mean
	Zaghloul					Sammany					Hayany					
	30 days	45 days	60 days	90 days	Mean	30 days	45 days	60 days	90 days	Mean	30 days	45 days	60 days	90 days	Mean	
F. oxysporum1	37.5	54.2	58.3	70.8	55.2	25.4	33.3	39.2	42.1	35.0	22.9	26.3	33.3	44.2	31.7	40.6
F. oxysporum2	25.4	33.3	35.4	45.8	35.0	17.5	19.2	20.4	21.7	19.7	12.5	15.0	15.4	18.8	15.4	23.4
F. oxysporum3	22.9	31.3	37.5	37.5	32.3	10.4	13.3	15.4	17.9	14.3	8.3	12.5	13.3	17.9	13.0	19.9
F. oxysporum4	33.3	40.8	50.0	58.3	45.6	21.3	22.5	26.3	33.3	25.8	18.3	20.4	23.8	33.3	24.0	31.8
F. oxysporum5	25.0	35.4	37.5	39.2	34.3	0.0	13.3	14.2	14.2	10.4	11.7	13.3	16.3	16.3	14.4	19.7
F. oxysporum6	25.0	33.3	35.0	39.2	33.1	0.0	15.8	16.7	17.5	12.5	8.3	15.8	16.7	17.5	14.6	20.1
F. moniliforme	0.0	25.0	27.1	35.4	21.9	0.0	0.0	15.8	16.7	8.1	11.7	13.3	15.4	16.7	14.3	14.8
F. solani	0.0	28.1	37.5	46.9	28.1	18.3	18.8	23.1	23.1	20.8	18.3	21.3	23.1	27.5	22.6	23.8
F. semitectum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. theobromae	0.0	29.2	33.3	38.3	25.2	15.8	17.5	19.2	20.4	18.2	7.5	13.3	17.9	21.3	15.0	19.5
T. Paradoxa	0.0	33.3	41.7	47.9	30.7	15.0	17.5	20.8	22.1	18.9	18.3	19.6	22.9	26.3	21.8	23.8
R. solani	0.0	25.0	29.2	31.3	21.4	0.0	9.2	13.3	14.2	9.2	8.3	10.8	14.2	15.8	12.3	14.3
Mean	14.1	30.7	35.2	40.9	30.2	10.3	15.0	18.7	20.3	16.1	12.2	15.1	17.7	21.3	16.6	21.0

L. S. D. at 0.05%				
	Fungi (F)	2.2	F * V	3.8
	Varieties (V)	1.1	F * T	4.4
	Period after inoculation (T)	1.3	V * T	2.2
	F * V * T	7.6		

Table (4): Pathogenicity test using different varieties of unwounded date palm seedlings after 30, 45, 60 and 90 days after inoculation.

Fungi	% Disease severity on date palm vars.															
	Zaghloul					Sammany					Hayany					Mean mean
	30 days	45 days	60 days	90 days	Mean	30 days	45 days	60 days	90 days	Mean	30 days	45 days	60 days	90 days	Mean	
F. oxysporum1	0.0	28.8	33.3	37.5	24.9	13.3	19.2	20.8	23.8	19.3	13.3	19.2	20.8	23.8	19.3	21.1
F. oxysporum2	0.0	15.8	20.0	22.5	14.6	0.0	10.4	14.2	15.8	10.1	0.0	8.3	8.3	10.8	6.9	10.5
F. oxysporum3	0.0	13.3	19.2	20.8	13.3	0.0	8.3	12.5	14.6	8.9	0.0	8.3	10.4	11.7	7.6	9.9
F. oxysporum4	0.0	22.9	26.3	27.1	19.1	0.0	13.3	18.8	20.8	13.2	0.0	13.3	17.1	20.8	12.8	15.0
F. oxysporum5	0.0	18.3	21.7	23.3	15.8	0.0	0.0	13.3	14.2	6.9	0.0	8.3	10.8	12.5	7.9	10.2
F. oxysporum6	0.0	12.5	16.7	17.5	11.7	0.0	0.0	13.8	15.8	7.4	0.0	8.3	10.8	13.3	8.1	9.1
F. moniliforme	0.0	13.3	15.8	20.0	12.3	0.0	8.3	15.4	17.5	10.3	0.0	8.3	10.8	12.5	7.9	10.2
F. solani	0.0	24.4	28.1	31.3	20.9	0.0	13.3	18.3	20.6	13.1	0.0	17.9	19.6	22.5	15.0	16.3
F. semitectum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. theobromae	0.0	0.0	12.5	13.3	6.5	0.0	12.5	14.2	17.1	10.9	0.0	12.5	14.2	17.1	10.9	9.4
T. Paradoxa	0.0	0.0	22.5	25.4	12.0	0.0	15.4	19.2	22.9	14.4	0.0	16.3	19.2	23.3	14.7	13.7
R. solani	0.0	0.0	10.8	12.5	5.8	0.0	10.8	14.6	15.8	10.3	0.0	15.8	16.7	18.3	12.7	9.6
Mean	0.0	12.4	18.9	20.9	13.1	1.1	9.3	14.6	16.6	10.4	1.1	11.4	13.2	15.6	10.3	11.3

L. S. D. at 0.05%	Fungi (F)	1.5	F * V =	2.6
	Varieties (V)	0.7	F * T =	2.9
	Period after inoculation (T)	0.9	V * T =	1.5
	F * V * T	5.1		

Varietal reaction:

Date palm offshoots of three varieties, *viz*. Zaghloul, Sammany and Hayany were used to study their susceptibility to the pathogenic fungi, *F. oxysporum*, *F. moniliforme*, *F. solani*, *B. theobromae*, *T. paradoxa* and *R. solani*. Data in Table (5) show that wounded offshoots of all the tested varieties were susceptible to infection at different levels. Zaghloul var. was the most susceptible with the tested fungi, followed by Hayany, while Sammany was the least susceptible. On the other hand, *F. oxysporum* and *F. solani* were the most virulent (23.01 and 14.35%DS, respectively), while *T. paradoxa* and *F. moniliforme* (12.59 and 10.46% DS, respectively) were moderately virulent, as well as *B. theobromae* and *R. solani* (9.63 and 8.24%DS, respectively) were the weak virulent. Increasing time after inoculation was significant with all fungi and cultivars. Data in Table (6) indicate that when unwounded method was used, all fungi were pathogenic to all varieties of date palm offshoots. *F. oxysporum*, *F. moniliforme* and *T. paradoxa* were the most virulent to date palm offshoots (13.33, 8.93 and 7.98%DS, respectively), while *F. solani* and *B. theobromae* (6.23 and 5.94%DS, respectively) were moderately virulent, while *R. solani* was the weak virulent (3.46%DS). On the other hand, Hayany var. was the most susceptible to all pathogenic fungi, followed by Sammany which was moderately susceptible, while Zaghloul was the least susceptible one. Periods after inoculation were significant with all fungi and cultivars.

Table (5): Pathogenicity test on different cultivars of wounded date palm offshoots at 3, 6 and 9 months after inoculation.

Fungi	%Disease severity on date palm vars.												Main Mean
	Zaghloul				Sammany				Hayany				
	3 Months	6 Months	9 Months	Mean	3 Months	6 Months	9 Months	Mean	3 Months	6 Months	9 Months	Mean	
F. oxysporum 1	20.42	24.17	45.42	30.00	15.83	16.67	21.67	18.06	18.75	20.83	23.33	20.97	23.01
F. solani	16.25	18.75	21.25	18.75	11.67	12.92	14.58	13.06	10.42	10.83	12.50	11.25	14.35
T. Paradoxa	13.33	15.42	17.50	15.42	9.58	11.25	13.33	11.39	10.42	10.83	11.67	10.97	12.59
F. moniliforme	10.42	11.67	15.42	12.50	7.08	8.75	10.83	8.89	7.50	10.42	12.08	10.00	10.46
B. theobromae	7.92	10.42	11.67	10.00	7.92	9.17	11.25	9.45	8.33	8.75	11.25	9.44	9.63
R. solani	7.50	8.33	10.83	8.89	5.42	5.83	8.33	6.53	8.33	9.17	10.42	9.31	8.24
Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	10.83	12.68	17.44	13.65	8.21	9.23	11.43	9.62	9.11	10.12	11.61	10.28	11.18

L. S. D. at 5%

Fungi (F)	0.94	F * V	1.73
Cultivars (V)	0.62	F * T	1.73
Period after inoculation (T)	0.62	T * V	1.22
F * V * T	2.99		

Table (6): Pathogenicity test on different cultivars of unwounded date palm offshoots at 3, 6 and 9 months after inoculation.

Fungi	%Disease severity on date palm vars.												
	Zaghloul				Sammany				Hayany				Main Mean
	3 Months	6 Months	9 Months	Mean	3 Months	6 Months	9 Months	Mean	3 Months	6 Months	9 Months	Mean	
F. oxysporum 1	12.50	14.17	17.08	14.58	11.67	15.83	18.33	15.28	7.92	10.42	12.08	10.14	13.33
T. Paradoxa	9.17	11.25	12.92	11.11	8.67	9.08	9.58	9.11	5.83	6.42	7.42	6.56	8.93
F. solani	6.25	7.50	8.75	7.50	7.08	8.33	11.67	9.03	5.83	7.92	8.50	7.42	7.98
F. moniliforme	3.67	6.33	6.83	5.61	3.50	6.25	8.33	6.03	5.33	7.08	8.75	7.05	6.23
B. theobromae	5.92	6.33	6.42	6.22	5.75	6.17	6.58	6.17	4.67	5.42	6.42	5.50	5.96
R. solani	3.25	3.83	4.25	3.78	2.92	3.17	3.58	3.22	2.92	3.33	3.92	3.39	3.46
Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	5.82	7.06	8.04	6.97	5.66	6.98	8.30	6.98	4.64	5.80	6.73	5.72	6.56

L. S. D. at 5%

Fungi (F)	0.43	F * V	0.73
Cultivars (V)	0.28	F * T	0.73
Period after inoculation (T)	0.28	T * V	n.s.
F * V * T	n.s.		

Discussion

Date palms under the Egyptian conditions are subjected to infection with different diseases caused by many soil-borne pathogenic fungi causing considerable root rot in the orchards (Abbas *et al*., 1989 and El-Deep, 1994). The present study aimed to carry out an accurate: survey and identification of fungi associated with root rot of date palm. Many researchers reported that soil-borne pathogenic fungi are the mostly responsible for root rot diseases which cause considerable losses of date palm and offshoots (El- Deep, 1994 and Abdalla *et al*., 2000). They mentioned that *F. oxysporum*, *F. solani* and *F. moniliforme* were isolated from the declined date palm trees. Root rot caused by soil-borne pathogenic fungi, *viz*. *F. oxysporum*, *F. moniliforme*, *F. solani*, *B. theomromae*, *T. paradoxa* and *R. solani* were isolated from root rotted samples collected from Aswan, Behera, Giza, Ismailia, Luxor, Sharkyia and Marsa-Matrouh governorates. While other fungi were less frequent. Results of the present study indicated that the root rot diseases were noticed on date palm grown in different localities belonging to the seven governorates in Egypt. El-Arosi *et al*. (1983) reported that symptoms on date palm infected by *F. moniliforme* and *F. solani* appeared on root as pale brown discoloration on the adventitious roots. The occurrence and frequency of the isolated fungi were differed from one location to another; these differences are probably due to the environmental conditions such as moisture, temperature and soil type, dissemination factors of fungi in different locations and agricultural practices. These results are in harmony with those obtained by Fawcett and Klotz (1932). Variations were recorded on the disease incidence and disease severity percentage in the inspected governorates. These results are in agreement with those obtained by El-Deep *et al*. (2007) who mentioned that these variations might be due to the variation in environmental conditions. It may be also due to one or more of the following factors; 1- pathogen frequency, 2- climatic conditions which differ considerably between locations, 3- varietal sensitivity, 4- dissemination factors available in the locality, 5- it may be also due to the cultural practices (Turner, 1981). *Fusarium* spp. were the most frequently isolated fungi from all governorates studied. Also, *Fusarium* spp. were the highly prevailed in healthy and infected date palm and offshoots. Mandel *et al*. (2005) showed that *Fusarium solani*

and *F. oxysporum* were predominant in the rhizosphere of date palm. *Fusarium* spp. were the most frequently isolated fungi from roots, but they showed the highest mean recovery of *Fusarium* spp. from the plant debris followed by the roots and the lowest one was occurred in the soil samples. On the other hand, *T. paradoxa* was consistently isolated from rotted roots of date palm, these results are in agreement with those obtained by Al-Rokibah *et al*. (1998) and Samir *et al*. (2009). On the other hand, Djerbi (1991) mentioned that *T. paradoxa* was not isolated from the roots of naturally infested trees. This may be due to the presence of various biotypes of the fungus in different regions (Al-Rokibah *et al*., 1998). The pathogenic potentialities of the isolated fungi were determined with three date palm vars. In the greenhouse, all wounded seedlings of date palm varieties were infected with all soil-borne pathogenic fungi, but with various degrees of susceptibility. The most virulent fungus was *Fusarium oxysporum*, followed by *T. paradoxa*, while *F. moniliforme*, *F. solani* and *B. theobromae* were moderately virulent. *R. soalni* was weak virulent to date palm. Hayany variety was the most susceptible to root rot followed by Sammany var., while Zaghloul var. was the less susceptible. These results are in agreement with those obtained by El-Deep *et al*. (2007).

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حصر وتعريف لأهم الفطريات التى تسبب مرض عفن الجذور وأهميتها على نخيل البلح فى مصر

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تتعرض أشجار النخيل ، تحت الظروف المصرية للإصابة بالأمراض المختلفة التي تسببها العديد من فطريات التربة مما يتسبب عنها تعفن جذور الشتلات والأشجار الكبيرة وموتها فى حالات الإصابة الشديدة. أجري الحصر المرضى خلال أربعة أعوام 2005-2008 لتحديد الفطريات التى تصيب جذور نخيل البلح في سبع محافظات (أسوان، الأقصر، مرسى مطروح ، الجيزة، الاسماعيلية، الشرقية والبحيرة). تم إختيار هذه المحافظات على أساس: المساحة المنزرعة، أصناف النخيل المختلفة، ونظام الري، والظروف الجوية المختلفة وإختلاف نوع التربة. وأظهرت النتائج أن أمراض أعفان الجذور وجدت في جميع المحافظات ولكن بنسب مختلفة من حيث نسبة وشدة الاصابة، والتى نتجت عن العديد من الفطريات الممرضة. وأوضحت نتائج التشخيص المرضى أن محافظة أسوان كانت أعلى فى شدة الإصابة بنسبة (45.00٪)، تليها الأقصر (37.50٪)، البحيرة (30.50٪)، مرسى مطروح (25.00 ٪)، الاسماعيلية (5.00٪)، الشرقية (3.75 ٪)، والجيزة (2.50 ٪). وأظهرت نتائج العزل المعملى أن أعلى نسبة تكرار كانت للإنواع المختلفة لجنس فيوزاريوم، يليها الفطر ثيلافيبسوس بارادوكسا، وأخيرا الفطر بيترودبلوديا ثيوبرومى والفطر ريزوكتونيا سولانى. الفطر فيوزرايوم اوكسيسبورم كان الأشد فى القدرة المرضية يليه الفطر فيوزاريوم مونيليفورم والفطر فيوزاريوم سولانى وأخيرا الفطر ثيلافيبسوس بارادوكسا وهى الفطريات المسئولة عن إحداث مرض عفن الجذور والتي تسبب الاصفرار التدريجي للاشجار المصابة ثم يليها موت الاشجار. جميع أصناف النخيل المختبرة كانت قابلة للإصابة بالفطريات المسببة لمرض عفن الجذور. وكان الصنف حيانى الأكثر قابلية للإصابة يليه الصنف سمانى وأخيرا الصنف زغلول.